This work is an experimental study and fabrication of design concepts to validate the feasibility of smart materials and their applications in bio-inspired robotics. Shape-Memory Alloy (SMA) springs are selected as the smart material actuators of interest to achieve locomotion in the proposed mobile robot. Based on a previous design of the robot, this work focuses on both implementing a new locomotion concept and reducing size and weight of the previous design, both using SMA-based actuators. Objectives are met in consideration of the conceptual mechanics of circular robot locomotion.

The first prototype is a variation of the original design. It consists of a soft, rubber outer shell with three intrinsically attached diametric SMA springs that deform the outer shell during contraction and relaxation. The springs were provided with electrical current in patterns to produce deformation needed to generate momentum and allow the robot to tumble and roll. This design was further improved to provide more stability while rolling.

The second design concept is a modification of our previous design leading to reduction in size and weight while maintaining essentially the same mechanism of locomotion. In this case, the SMA springs were externally configured between the end of equi-spaced spokes and the circular core. Upon actuation, the spokes function as diametrically translating legs to generate locomotion. These design concepts are fabricated and experimented on, to determine their feasibility, i.e. whether rolling/tumbling motion is achieved. The scope of the project was limited to demonstration of basic locomotion, which was successful. Future work on this project will address the design of automatic control to generate motion using closed-loop sensor-based actuation.